FRITSCH

Operating instructions

PLANETARY MILL

PULVERISETTE 5 *classic line*

Valid starting with: 05.50X0/01000

Valid starting with: 05.60X0/03000



Read the instructions prior to performing any task!

Translation of the original operating instructions

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Certifications and CE conformity

Certification

Fritsch GmbH has been certified by the SGS-TÜV Saar GmbH.

An audit certified that Fritsch GmbH conforms to the requirements of the DIN EN ISO 9001:2015.

CE Conformity

The enclosed Conformity Declaration lists the guidelines the FRITSCH instrument conforms to, to be able to bear the CE mark.

Table of contents

1 Basic structure 7

2 Safety information and use 8

2.1 Requirements for the user 8
2.2 Scope of application 8
2.2.1 Operating principle 9
2.2.2 Drive motor and speed regulation 9
2.3 Obligations of the operator 9
2.4 Information on hazards and symbols used in this manual 10
2.5 Device safety information 12
2.6 Protective equipment 13
2.6.1 Opening the hood without mains connection 14
2.6.2 Imbalance check 14
2.7 Hazardous points 15
2.8 Electrical safety 15
2.8.1 General information 15
2.8.2 Protection against restart 16
2.8.3 Overload protection 16
2.8.4 Imbalance detection 16
2.8.5 Operation on GFCI (Ground-Fault Circuit Interrupters) 16

3 Technical data 17

3.1 Dimensions 17
3.2 Weight 17
3.3 Operating noise 17
3.4 Voltage 17
3.5 Current consumption 17
3.6 Power consumption 18
3.7 Electrical fuses 18
3.8 Material 18
3.9 Final fineness 18

4 Installation 19

4.1 Transport 19
4.2 Unpacking 19
4.3 Setting up 20
4.4 Ambient conditions 21
4.5 Electrical connection 21
4.6 Settings in setup mode 23
4.6.1 Setting the imbalance check 23
4.6.2 Setting time units 24
4.6.3 Setting device specifications 25

5 Initial start-up 26

5.1 Switching on 26

5.2 Function check ... 26

6 Using the device ... 27

6.1 Choice of grinding bowls and grinding balls ... 27
6.1.1 Size of the grinding balls ... 29
6.1.2 Recommended number of balls per grinding bowl (independent of the material quantity) ... 30
6.1.3 Average calculated weight of a ball ... 31
6.2 Filling quantities of grinding bowls ... 31
6.3 Filling the grinding bowl ... 32
6.4 Factors with an impact on grinding ... 33
6.4.1 Running time (grinding duration) ... 33
6.4.2 Speed ... 33
6.4.3 Reverse mode ... 33
6.4.4 Number and size of the balls ... 34
6.4.5 Weight of the balls (type of material) ... 34
6.4.6 Dry grinding ... 34
6.4.7 Wet grinding (grinding in a suspension) ... 35
6.5 Clamping the grinding bowls ... 35
6.5.1 Clamping with the "Safe-Lock" (5) tensioning device ... 35
6.5.2 Clamping the 80 ml grinding bowls ... 38
6.6 Mass balance ... 38
6.7 Grinding duration ... 39
6.8 Settings on the control panel ... 40
6.8.1 Setting the speed ... 40
6.8.2 Setting the running time ... 40
6.9 Repetition of grinding / pause cycles ... 41
6.10 Reverse mode ... 41
6.11 Conducting a grinding operation ... 42
6.11.1 Overload ... 42
6.11.2 Switching off ... 42
6.12 Cooling the grinding bowl ... 43
6.13 Stand-by ... 43

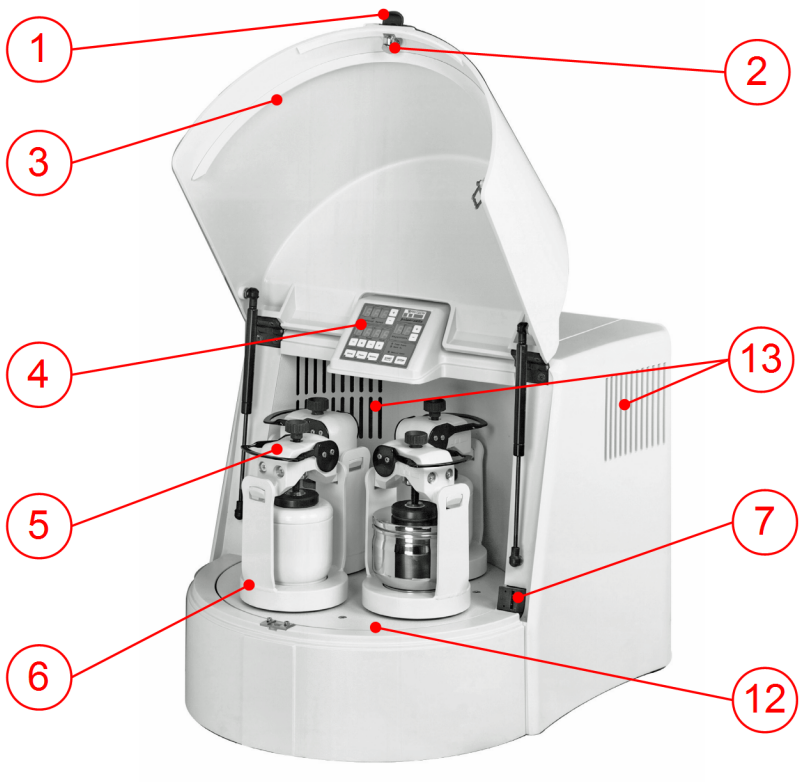
7 Accessories ... 44

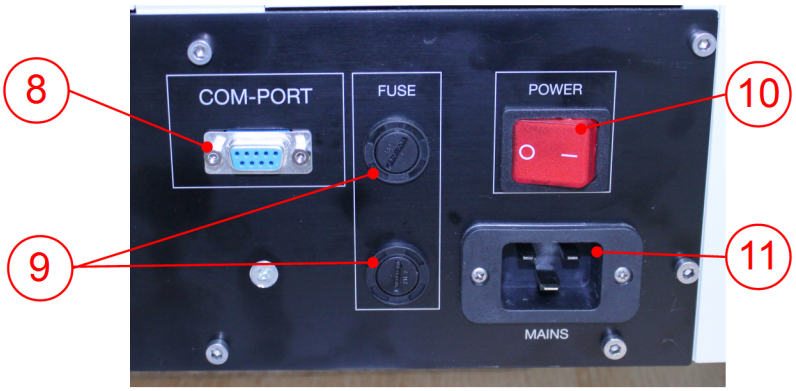
7.1 Additional clamping system for grinding harmful substances or in a gas atmosphere ... 44
7.1.1 Locking the additional clamping system into place ... 44
7.2 Grinding in inert gas with gassing lid ... 48
7.2.1 Preparation for gassing ... 49
7.2.2 Gassing ... 50
7.2.3 Ventilate after grinding ... 50
7.2.4 Cleaning the valves ... 51
7.2.5 Installing valve inserts ... 51
7.3 GTM - system ... 52

Table of contents

8 Cleaning 53
8.1 Grinding elements 53
8.2 Device 54
9 Maintenance 55
10 Repairs 57
10.1 Checklist for troubleshooting 57
10.2 Error messages 58
11 Examples of comminution tasks 59
12 Disposal 61
13 Guarantee terms 62
14 Exclusion of liability 64
15 Safety logbook 66
16 Index 67

1 Basic structure





1 Hood handle
2 Latch
3 Hood
4 Control panel
5 Safe-Lock
6 Bowl holder
7 Lock
8 COM-PORT
9 2 x fine wire fuse
10 Main switch
11 Mains cennection
12 Cover plate
13 Ventilation grid

2 Safety information and use

2.1 Requirements for the user

This operating manual is intended for persons assigned with operating and monitoring the Fritsch PULVERISETTE 5. The operating manual and especially its safety instructions are to be observed by all persons working on or with this device. In addition, the applicable rules and regulations for accident prevention at the installation site are to be observed. Always keep the operating manual at the installation site of the PULVERISETTE 5.

People with health problems or under the influence of medication, drugs, alcohol or exhaustion must not operate this device.

The PULVERISETTE 5 may only be operated by authorised persons and serviced or repaired by trained specialists. All commissioning, maintenance and repair work may only be carried out by technically qualified personnel. Qualified personnel are persons who, because of their education, experience and training as well as their knowledge of relevant standards, regulations, accident prevention guidelines and operating conditions, are authorised by those responsible for the safety of the machine to carry out the required work and are able to recognize and avoid possible hazards as defined for skilled workers in IEC 364.

In order to prevent hazards to users, follow the instructions in this manual.

Malfunctions that impair the safety of persons, the PULVERISETTE 5 or other material property must be rectified immediately. The following information serves both the personal safety of operating personnel as well as the safety of the products described and any devices connected to them: All maintenance and repair work may only be performed by technically qualified personnel.

This operating manual is not a complete technical description. Only the details required for operation and maintaining usability are described.

Fritsch has prepared and reviewed this operating manual with the greatest care. However, no guarantee is made for its completeness or accuracy.

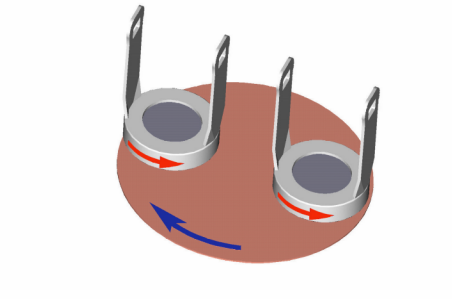
Subject to technical modifications.

2.2 Scope of application

The PULVERISETTE 5 *classic line* can be applied universally for the fast, dry or wet grinding of inorganic and organic samples for analysis, quality inspection, material testing or mechanical alloying. During the synthesis, the PULVERISETTE 5 is used for mixing and homogenising dry samples, emulsions or suspensions.

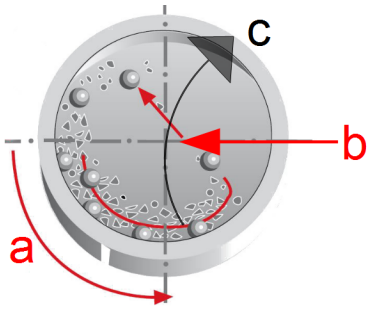
2.2.1 Operating principle

The grinding stock is crushed and ground by grinding balls in 2 or 4 grinding bowls. The centrifugal forces from the rotation of the grinding bowls around their own axis and from the rotating support disc act on the contents of the grinding bowl which consists of material to be ground and grinding balls.



The grinding bowl and the support disc have opposite directions of rotation, so that the centrifugal forces alternate in the same direction and in the opposite direction. The result is that the grinding balls run down the inside of the bowl's wall as friction effect and the grinding balls hit the opposite wall of the grinding bowl as impact effect. The impact effect is amplified by the impact of the grinding balls against each other.

The loss-free comminution, even when grinding suspensions, is ensured by the hermetic seal between the grinding bowl and the lid.



a Rotation of the grinding bowl
b Centrifugal force
c Movement of the support disc

2.2.2 Drive motor and speed regulation

A maintenance-free three-phase motor operated via a frequency converter is used as the drive.

2.3 Obligations of the operator

Before using the PULVERISETTE 5, this manual is to be carefully read and understood. The use of the PULVERISETTE 5 requires technical knowledge; only commercial use is permitted.

The operating personnel must be familiar with the content of the operating manual. For this reason, it is very important that these persons actually receive the present operating manual. Ensure that the operating manual is always near the device.

The PULVERISETTE 5 may exclusively be used within the scope of applications set down in this manual and within the framework of guidelines put forth in this manual. In case of non-compliance or improper use, the customer assumes full liability for the functional capability of the PULVERISETTE 5 and for any damage or injury arising from failure to fulfil this obligation.

By using the PULVERISETTE 5 the customer agrees with this and recognizes that defects, malfunctions or errors cannot be completely excluded. To prevent risk of damage to persons or property or of other direct or indirect damage, resulting from this or other causes, the customer must implement sufficient and comprehensive safety measures for working with the PULVERISETTE 5.

Neither compliance with this manual nor the conditions and methods used during installation, operation, use and maintenance of the PULVERISETTE 5 can be monitored by Fritsch GmbH. Improper execution of the installation can result in property damage and thus endanger persons. Therefore, we assume absolutely no responsibility or liability for loss, damage or costs that result from errors at installation, improper operation or improper use or improper maintenance or are in any way connected to these.

The applicable accident prevention guidelines must be complied with.

Generally applicable legal and other obligatory regulations regarding environmental protection must be observed.

2.4 Information on hazards and symbols used in this manual

Safety information

Safety information in this manual is designated by symbols. Safety information is introduced by keywords that express the extent of the hazard.



DANGER!

This symbol and keyword combination points out a directly hazardous situation that can result in death or serious injury if not avoided.



WARNING!

This symbol and keyword combination points out a possibly hazardous situation that can result in death or serious injury if not avoided.



CAUTION!

This symbol and keyword combination points out a possibly hazardous situation that can result in slight or minor injury if not avoided.



NOTICE!

This symbol and keyword combination points out a possibly hazardous situation that can result in property damage if not avoided.

Special safety information

To call attention to specific hazards, the following symbols are used in the safety information:



DANGER!
This symbol and keyword combination points out a directly hazardous situation due to electrical current. Ignoring information with this designation will result in serious or fatal injury.



DANGER!
This symbol and keyword combination designates contents and instructions for proper use of the machine in explosive areas or with explosive substances. Ignoring information with this designation will result in serious or fatal injury.



DANGER!
This symbol and keyword combination designates contents and instructions for proper use of the machine with combustible substances. Ignoring information with this designation will result in serious or fatal injury.



WARNING!
This symbol and keyword combination points out a directly hazardous situation due to movable parts. Ignoring information with this designation can result in hand injuries.



WARNING!
This symbol and keyword combination points out a directly hazardous situation due to hot surfaces. Ignoring information with this designation can result in serious burn injuries due to skin contact with hot surfaces.

Safety information in the procedure instructions

Safety information can refer to specific, individual procedure instructions. Such safety information is embedded in the procedure instructions so that the text can be read without interruption as the procedure is being carried out. The keywords described above are used.

Example:

1. Loosen screw.
2. **CAUTION!**
   Risk of entrapment at the lid.

   Close the lid carefully.
3. Tighten screw.

Tips and recommendations

This symbol emphasises useful tips and recommendations as wells as information for efficient operation without malfunction.

2.5 Device safety information

Please observe!

- Only use original accessories and original spare parts. Failure to observe this instruction can compromise the safety of the machine.
- Safe conduct must be strictly observed during all work.
- All currently applicable national and international accident prevention guidelines must be complied with.



CAUTION!

Wear hearing protection!

If a noise level of 85 dB(A) is reached or exceeded, ear protection should be worn to prevent hearing damage.

WARNING!

The maximum accepted concentration (MAC) levels of the relevant safety guidelines must be observed; if necessary, ventilation must be provided or the machine must be operated under an extractor hood.



DANGER!

Explosion hazard!

– When Grinding oxidisable substances, e.g. metal or coal, there is a risk of spontaneous combustion (dust explosion) if the proportion of fine particles exceeds a certain percentage. When Grinding these kinds of substances, special safety measures must be taken and the work must be supervised by a specialist.
– The device is not explosion-protected and is not suitable for Grinding explosive materials.

- Do not remove the information signs.

NOTICE!

Immediately replace damaged or illegible information signs.

- Unauthorised alteration of the device will void Fritsch's declaration of conformity to European directives and void the guarantee.
- The PULVERISETTE 5 should only be used when it is in proper working order, as intended and in a safety- and hazard-conscious manner adhering to the operating manual. In particular, immediately rectify any malfunctions that could pose a safety hazard.
- If, after reading the operating manual, there are still questions or problems, please do not hesitate to contact our specialised personnel.
- Do not reuse damaged accessories.
- Do not leave the Laboratory planetary mill running for several hours without cooling phases. Risk of overheating!
- The mill must never be left running unsupervised. In certain operating states, the vibrations may result in a shifting effect on the surface.

2.6 Protective equipment

Protective equipment is to be used as intended and may not be disabled or removed.

All protective equipment is to be regularly checked for integrity and proper functioning.

For start-up, the hood (3) has to be closed.

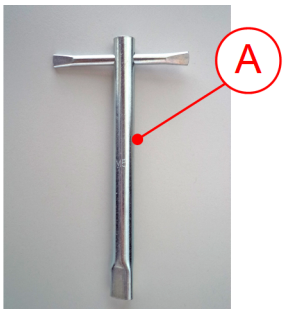
The hood (3) is locked:

- without mains connection
- during operation

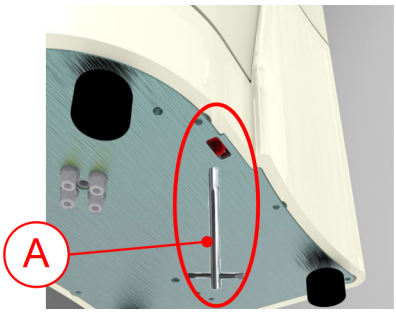
The hood (3) can only be opened, if the mill's drive is at standstill.

2.6.1 Opening the hood without mains connection

NOTICE!
Use the emergency release only if a power failure or damage to the device prevents normal opening. Only open the emergency release gently and turn the triangular key 180 degrees clockwise. Any other manner of handling can damage the locking mechanism, rendering the mill unusable.



CAUTION!
The emergency release must not be activated while the machine is running! Disconnect the machine from the mains before the emergency release. Failure to observe this will render void the guarantee, and releases us from liability for any resulting damage to the device or personal injury.



1. Insert the included triangular key (A) into the bore hole on the bottom side of the PULVERISETTE 5 *classic line* and turn it clockwise 180 degrees.
2. Unlock the latch (2) by pressing the hood handle (1).
3. The hood (3) can now be opened.
4. The mill can only be switched on again if the hood (3) is closed and the safety lock (7) has been reactivated by turning the triangular key 180 degrees anticlockwise.

2.6.2 Imbalance check

The device switches off if there is excessive imbalance. (See Chapter *Chapter 6.6 'Mass balance' on page 38*)

CAUTION!
The imbalance check can be disabled at your own risk. Fritsch assumes no liability for damage resulting from the deactivation of the imbalance check!

NOTICE!

Change these settings only after all work as described in ↳ *Chapter 4 'Installation' on page 19* has been carried out!

NOTICE!

The highest level of sensitivity is set for the imbalance check as the factory default. In order to adjust the imbalance check to suit your applications as best as possible, set the value for the imbalance check as explained in Chapter ↳ *Chapter 4.6.1 'Setting the imbalance check' on page 23*. Please note that you have to redefine this setting for various parameters with different grinding sets and balls.

2.7 Hazardous points

CAUTION!

– Crushing hazard when closing the hood (3).
– Crushing hazard at the grinding bowl safe-lock tensioning device (5).



CAUTION!

Risk of splashing!

During wet grinding, the high temperature may have created overpressure.

Wear protective goggles.



CAUTION!

The grinding bowls can be very hot after grinding.

Wear safety gloves.

2.8 Electrical safety

2.8.1 General information

- The main switch (10) separates the device from the mains on two poles.
- Switch off the main switch (10) if the planetary mono mill is down for a longer period of time (e.g. overnight).

2.8.2 Protection against restart

In case of power failure during operation or after switching off with the main switch (10), the hood (3) is locked. The hood lock (7) is opened when the power returns. For safety reasons, however, the mill does not restart.

2.8.3 Overload protection

- In the event of an overload, the device reduces the speed in a controlled manner. The REDUCED SPEED light is lit as a warning.
- The device switches off if the drive motor becomes too hot.
- The device switches off if the drive is blocked. (See *Chapter 10 'Repairs' on page 57*)

2.8.4 Imbalance detection

Bei starker Unwucht schaltet das Gerät ab. (siehe *Chapter 6.6 'Mass balance' on page 38* und *Chapter 2.6.2 'Imbalance check' on page 14*)

2.8.5 Operation on GFCI (Ground-Fault Circuit Interrupters)

It is possible that the leakage currents will become marginal during operation. This may trigger the earth leakage circuit breaker. These values can quickly be reached when all devices are added to the circuit.

Solution: Circuit without an earth leakage circuit breaker or, if possible, increase the earth leakage circuit breaker threshold.

3 Technical data

3.1 Dimensions

When the hood is open

952 x 581 x 669 mm (height x width x depth)

When the hood is closed

570 x 581 x 669 mm (height x width x depth)

3.2 Weight

Net:

100 kg with 2 bowl holders

120 kg with 4 bowl holders

Gross:

approximately 140 kg with 2 bowl holders

approximately 160 kg with 4 bowl holders

3.3 Operating noise

Emissions value of workplace according to DIN EN ISO 3746:2005 is 74.9 dB(A) with a grinding element made from steel and grinding stock of sand! This value may vary depending on the type of grinding element and sample material.

3.4 Voltage

- Single phase alternating current 100 - 120V ± 10%, and,
- Single phase alternating current 200 - 240V ± 10%.
  Transient overvoltage according to overvoltage category II is permitted.

3.5 Current consumption

Depending on the voltage range, the maximum current consumption is as follows:

- 100 - 120V → 12,8 A
- 200 - 240V → 7,5 A

3.6 Power consumption

Depending on the voltage range, the maximum power consumption is as follows:

- 115 V → 1470 W
- 230 V → 1730 W

3.7 Electrical fuses

2 x fine fuse: 6,3 x 32 mm; 15 A

3.8 Material

- Maximum feeding size 10 mm
- Maximum feeding volume
  900ml divided into 4 x 500ml grinding bowls + grinding balls or
  450ml divided into 2 x 500ml grinding bowl + grinding balls
- Achievable mean final fineness of up to $d_{50} < 1$ µm

3.9 Final fineness

- Dry grinding up to $d_{50} < 20$ µm (depending on the material)
- Wet grinding up to $d_{50} < 1$ µm (depending on the material)

4 Installation

4.1 Transport

The device is delivered on a transport pallet with a wooden cover. We recommend using a forklift or pallet truck for transporting the packed device.



DANGER!
Do not step under the transport pallet during transport.

WARNING!
Improper lifting can lead to personal injury or property damage. The machine is only to be lifted with suitable equipment and by qualified personnel.

The guarantee excludes all claims for damage due to improper transport.

4.2 Unpacking

- Pull out the nails that fasten the lid to the surrounding packaging.
- Remove the lid.
- Take out the accessories.
- Pull out the nails that fasten the surrounding packaging to the transport pallet.
- Then lift the wooden surround over and away from the device.
- The pre-perforated segments can be detached so that the foam parts can be removed more easily.
- Please store the transport packaging so that it can be reused if you need to return the product. Fritsch GmbH accepts no liability for damage caused by improper packaging (packaging that is not from Fritsch).
- Compare the contents of the delivery with your order.

Grinding bowls made of tempered steel may have recesses on the surface caused during production. They do not have an impact on grinding or the grinding results and usually disappear after the first grinding operation.

These recesses on the surface, if present, are within the range of the permissible production tolerances. Complaints relating to such grinding bowls therefore cannot be accepted.

4.3 Setting up



DANGER!
Do not step under the transport pallet during transport.

CAUTION!
The weight of the planetary mill is approx. 120kg!

NOTICE!
Never operate the mill while it is standing on the transport pallet!

NOTICE!
Keep any obstructions away from the air outlet on the side ventilation grate. Risk of overheating!

- Lift the mill from the transport pallet.
- 6 screws connect the mill to the transport pallet. Remove the screws.
- Place the mill with the transport pallet back down.
- Lift the mill off the transport pallet.
- Place the mill on a flat, stable surface. It is not necessary to fasten it in place.
  The mill can be placed on a stable table.
- Make sure that the mill is easily accessible. There has to be sufficient space to reach the main switch on the back side of the device.

4.4 Ambient conditions

WARNING!

Mains voltage

– The device may only be operated indoors.
– The surrounding air must not contain any electrically conductive particles.
– Maximum relative humidity 80% for temperatures up to 31 °C, linearly decreasing down to 50% relative humidity at 40 °C.

- The room temperature should be between 5 and 40 °C.
- Altitudes up to 2000 m
- Degree of pollution 2 according to IEC 60664-1:2007.

4.5 Electrical connection

DANGER!

Provide short-circuit protection!

Risk of damage due to short-circuits.

– Make sure that the socket is connected to a mains line protected with a residual current circuit breaker.

DANGER!

Mains voltage!

Changes to the connection line may only be made by a qualified person.

CAUTION!

Ignoring the values on the type plate may result in damage to the electrical and mechanical components.

Before establishing the connection, compare the voltage and current values stated on the type plate with the values of the mains system to be used.

1. Plug the supplied power cord into the port (11) at the back of the device.
2. Then connect the device to the mains using the power cord!

Installation

NOTICE!

Fritsch mills are speed controlled. The devices are equipped for this with frequency converters. In order to comply with the EMC directive, many measures must be taken to prevent operational transient emissions.

The possible leakage currents resulting from filtering measures can trigger a conventional residual current circuit breaker in the mains line. **This is no defect!**

To prevent this, special residual current circuit breakers, which are adapted for operation with frequency converters, are commercially available.

Operation without a residual current switch is possible, but must be done in accordance with the relevant regulations.

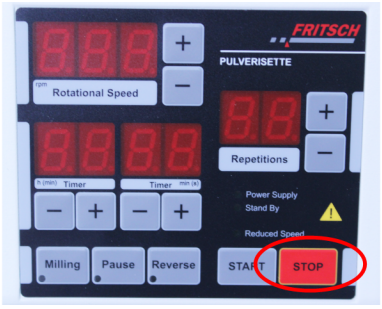
4.6 Settings in setup mode

4.6.1 Setting the imbalance check

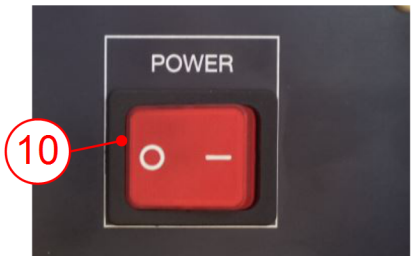
CAUTION!
The imbalance check can be disabled at your own risk. Fritsch assumes no liability for damage resulting from the deactivation of the imbalance check!

NOTICE!
The highest level of sensitivity is set for the imbalance check as the factory default. In order to adjust the imbalance check to suit your applications as best as possible, set the value for the imbalance check as explained in Chapter *Chapter 4.6.1 'Setting the imbalance check' on page 23*. Please note that you have to redefine this setting for various parameters with different grinding sets and balls.

Activation / deactivation of the imbalance check in setup mode:



1. Press and hold the STOP button on the front of the control panel.



2. Switch on the device with the main switch (10) on the back of the device. There is a brief display check. After roughly 3 seconds setup mode is started and the STOP button can be released.



3. If POWER SUPPLY is flashing, the device is in setup mode. If POWER SUPPLY is not flashing, repeat the procedure.



4.

NOTICE!

The display above the right "–" button (x) in the TIMER field is set to 9 by default. This indicates that the imbalance check has been preconfigured to the highest sensitivity level, preventing the device from shifting position and any resulting damage to the device. "1" indicates low sensitivity and with "9" only slight imbalance is required and the machine shuts down.

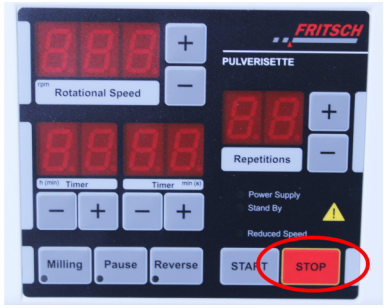
When the imbalance check is deactivated, a "0" will be displayed in the TIMER field over the right "–" button (x)!



5. To save and exit setup mode, press the STOP button.

After starting up (see Chapter ↪ Chapter 5 'Initial start-up' on page 26) begin grinding with 2 (4) bowls of the same weight. If the machine stops and the error code "UnbA" is displayed, press STOP and change the value for the imbalance check from 9 to 8 in setup mode. Repeat this process until your grinding is performed with the parameters you require.

4.6.2 Setting time units

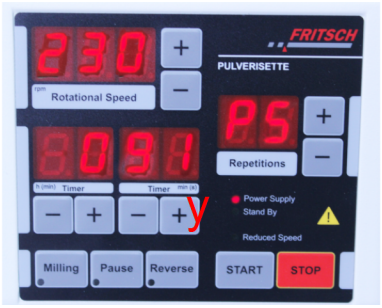


1. When the device has been switched off, press and hold the STOP button on the front control panel.



2. Switch on the device with the main switch (10) on the back of the device. There is a brief display check. After about 3 seconds setup mode is started and the STOP button can be released.

3. If POWER SUPPLY is flashing, the device is in setup mode. If POWER SUPPLY is not flashing, repeat the procedure.



4. To perform changes, press the right "+" button (y) in the TIMER field:

Time unit, hours and minutes → display: -

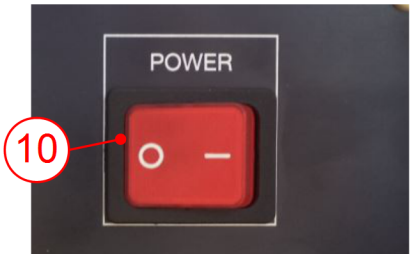
Time unit, minutes and seconds → display: 1 (factory setting)

5. To save and end setup mode, press the STOP button.

4.6.3 Setting device specifications

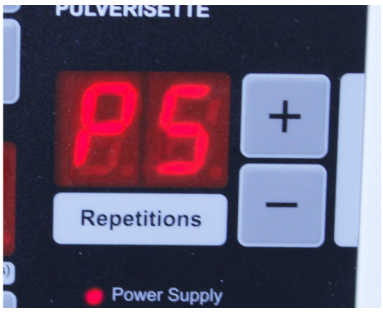


1. Press and hold the STOP button on the front of the control panel.



2. Switch on the device with the main switch (10) on the back of the device. There is a brief display check. After about 3 seconds setup mode is started and the STOP button can be released.

3. If POWER SUPPLY is flashing, the device is in setup mode. If POWER SUPPLY is not flashing, repeat the procedure.



4.

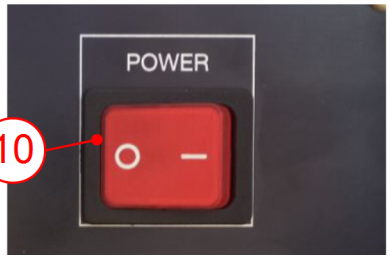
NOTICE!

"P5" must always be displayed in the REPETITIONS field. The Fritsch company will give no guarantee for damage resulting from disabling of the imbalance switch.

5 Initial start-up

Perform initial start-up only after all work as described in *Chapter 4 'Installation' on page 19* has been carried out.

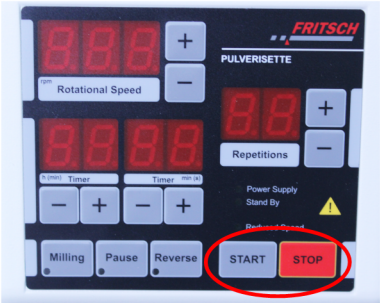
5.1 Switching on



- The device must be connected to the power supply if this has not been done already.
- Switch on the device with the main switch (10) on the back side of the device.
- The POWER SUPPLY lamp on the control panel lights up.

5.2 Function check

CAUTION!
Conduct the functional test at a speed of 100 1/min!



- Open the hood (3).
- Make sure that there are no small, loose pieces in the grinding chamber.
- Close the hood (3).
- Set the speed to 100 rpm (see *Chapter 6.8.1 'Setting the speed' on page 40*).
- Press START on the control panel.
- The hood (3) is locked and the mill starts up at the preselected speed.

6 Using the device

DANGER!

Before starting the machine, make sure that the grinding bowl has been tensioned correctly and that there are no loose parts inside the device. There is a risk of loose grinding bowls or parts being projected. Failure to observe this will render void the guarantee, and releases us from liability for any resulting damage to the device or personal injury.

NOTICE!

During grinding, high temperatures and high pressure may appear in the grinding bowl.

In encased grinding bowls, the inserts are glued into the casing with a two-component construction adhesive.

The adhesive is resistant to temperatures up to approx. 140 °C. Above 140 °C, the adhesive will liquefy. That can cause irreparable damage to the insert. The grinding bowl will definitely be rendered unusable.

The device requires a start-up phase at the beginning in order to reach maximum performance. A well-filled and heavy grinding set may initially operate at a lower speed than after running for approximately 1 - 2 hours.

6.1 Choice of grinding bowls and grinding balls

CAUTION!

If the grinding elements used are not genuine accessories, we assume no guarantee and exclude all liability for damage to the device or for personal injury.

Using the device

CAUTION!

The grinding element is subject to normal wear when used. Before every grinding operation, check the wall thickness of the grinding bowls. In the event of severe wear, replace the grinding bowl. If this is not done, the prevailing high centrifugal forces during grinding may cause the grinding balls to penetrate the bowl's wall and damage the mill. Failure to observe this will render void the guarantee and release us from liability for any resulting damage to the device or personal injury.

NOTICE!

Each grinding process means wear to the grinding element. Therefore, please pay attention to what components the material of the grinding element contains and whether these could react with the sample. Such reactions may have consequences. A simple reaction with minor consequences may be, for example, the grinding of samples containing sulphur in the steel bowl, which contains iron. The iron released by abrasion can combine with sulphur and react to form iron sulphide. This can lead to black deposits on your grinding set.

The hardness and density (specific weight) of the grinding bowl and grinding balls used have to be greater than that of the material used to prevent excessive wear by abrasion.

Material (bowl and balls)	Main components of the material	Density in g/cm³ High density means high impact energy!	Abrasion resistance	Use for grinding stock
Agate	(99.9% SiO_2)	2.65	Good	Soft to medium-hard samples
Silicon nitride	(90% Si_3N_4)	3.25	Extremely good	Abrasive samples, metal-free grinding
Sintered corundum	(99.7% Al_2O_3)	3.9	Fairly good	Medium-hard, fibrous samples
Zirconium oxide	(96.2% ZrO_2)	5.7	Very good	Fibrous, abrasive samples
Hardened, stainless steel	(16.0 - 18.0% Cr)	7.7	Fairly good	Medium-hard, brittle samples
Tungsten carbide	(93% WC+6% Co)	14.9	Very good	Hard, abrasive samples

The grinding bowls and grinding balls made of zirconium oxide are resistant to acids - apart from hydrofluoric acid.

Normally choose a grinding bowl and grinding balls that are made of the same material.

Exception: Tungsten carbide balls (< 20 mm) may be temporarily (a few minutes) combined with grinding bowls made of hardened steel.

6.1.1 Size of the grinding balls

Type of feed material	Suitable ball diameter
Hard samples with a maximum feed size of 10 mm	30 mm or 40 mm
Average feed size of < 5 mm	20 mm, 15 mm or 10 mm
Fine material < 0.5 mm	10 mm or smaller
Homogenisation of dry or liquid samples	20 mm or smaller
Homogenisation of viscous samples	20 mm

These are reference values: The size of bowls and grinding balls may need to be determined through experimentation.

NOTICE!
It is not advisable to mix balls of different diameters. If balls with different diameters are used, increased wear and damage to the grinding elements is to be expected.

NOTICE!
Balls with a diameter of 40 mm are rarely used for grinding, because this ball size can cause damage to the grinding bowl fast if the grinding duration is too long. Only use grinding balls of this diameter for brief grinding durations.

6.1.2 Recommended number of balls per grinding bowl (independent of the material quantity)

A higher number of balls will reduce the grinding time and the grinding result will have a smaller particle size distribution.

Ball diameter (mm)	Grinding bowl volume (ml)	80	250	500
5	Number of balls (pcs)	250	1200	2000
10	Number of balls (pcs)	25	50	100
15	Number of balls (pcs)	10	45	70
20	Number of balls (pcs)	5	15	25
30	Number of balls (pcs)	-	6	8
40	Number of balls (pcs)	-	-	4

Balls Ø 3mm and smaller				
Material	Grinding bowl volume (ml)	80	250	500
Zirconium oxide	Weight of balls (gram)	100	400	800
Hardened, stainless steel	Weight of balls (gram)	150	500	1100
Tungsten carbide	Weight of balls (gram)	300	1000	2100

These are reference figures: The number of balls may need to be determined through experimentation. The minimum number of balls advised is binding.



CAUTION!

When grinding with a ball size of Ø 30 mm or Ø 40 mm, do not let the device run unsupervised. The vibrations may lead to shifting.

6.1.3 Average calculated weight of a ball

Ball diameter in mm		5	10	15	20	30	40
Material	Density in g/cm³	Calculated weight of a ball in g					
Agate	2,65	0,17	1,39	4,68	11,1	37,46	88,8
Silicon nitride	3,25	0,21	1,7	5,74	13,61	45,94	108,91
Sintered corundum	3,9	0,25	2,04	6,89	16,33	55,13	130,69
Zirconium oxide	5,7	0,37	2,99	10,07	23,88	80,58	191,01
Hardened, stainless steel	7,7	0,50	4,03	13,60	32,25	108,86	258,03
Tungsten carbide	14,9	0,97	7,8	26,33	62,41	210,64	499,3

To determine the weight of the balls to be used, the "calculated weight of a ball" is multiplied by the "number" of balls required.

Example: A 250 ml agate bowl is to be filled with 1250 x 5 mm agate balls.

Calculation: 0.17 g * 1250 pcs ≈ 212.5 g

212.5 g of grinding balls can be weighed and inserted in the grinding bowl, thus avoiding the time required for counting the balls.

6.2 Filling quantities of grinding bowls

CAUTION!

For wet grinding with large balls with a diameter of >10 mm, at least half the maximum sample quantity must be inserted. If the suspension is highly fluid, the balls will not have any resistance and the balls and the grinding bowl could be damaged. The result is the same as if it had been filled with no grinding stock. The same applies to dry grinding with less than the minimum sample quantity.

NOTICE!

Never operate the mill without grinding stock! This can lead to grinding balls and grinding bowls getting damaged.

NOTICE!
If the minimum filling quantity is fallen short of, increased wear due to abrasion is to be expected. This can cause irreparable damage to the mill components.

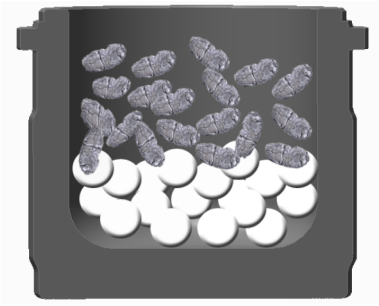
NOTICE!
The filled in volume can increase during the grinding. Check the volume after a brief grinding time.

Grinding bowl	Min. sample volumes	Max. sample volumes
500 ml	80 ml	225 ml
250 ml	30 ml	125 ml
80 ml	10 ml	30 ml

6.3 Filling the grinding bowl

CAUTION!
Do not fill in any dry ice of liquid nitrogen in the grinding bowls!
Adding dry ice or liquid nitrogen into the grinding bowls can lead to a sudden increase in volume with a high static pressure. This can result in an explosion of the grinding bowls.

Do not fail to comply with the following sequence:



1. Place the grinding balls in the empty bowl.
2. Fill grinding stock onto the balls.

NOTICE!
Make sure the sealing surface is clean and the seal is not damaged.

3. Place the lid on the grinding bowl.

6.4 Factors with an impact on grinding

6.4.1 Running time (grinding duration)

To reduce the grinding time, you can use a grinding bowl and grinding balls with a higher density, and thus a higher impact energy.

6.4.2 Speed

Higher speeds shorten the grinding time and increase the percentage of fine particles.

Lower speeds increase the grinding time and lower the temperature, which can lead to fewer pauses. This means that the overall working time may remain the same. The wear is increased in this case though.

Fritsch recommends however to use the maximum speed and to plan for enough pauses so that the wear is minimised.

For thermally sensitive materials, the optimal rotational speed needs to be determined through experimentation.

6.4.3 Reverse mode

- Useful for mechanical alloying
- Improvement of the homogeneity of the sample

6.4.4 Number and size of the balls

NOTICE!

It is not advisable to mix balls of different diameters. If balls with different diameters are used, increased wear and damage to the grinding elements is to be expected.

You can find the recommended number and size of balls in Chapter 6.1 'Choice of grinding bowls and grinding balls' on page 27.

Larger balls are used for pre-crushing. (See *Chapter 6.1.2 'Recommended number of balls per grinding bowl (independent of the material quantity)' on page 30*).

To increase the proportion of fine particles, the large balls need to be replaced by smaller ball sizes during the course of the grinding process.

6.4.5 Weight of the balls (type of material)

A higher mass (specific weight) of the grinding balls accelerates grinding. (see table in *Chapter 6.1 'Choice of grinding bowls and grinding balls' on page 27*).

6.4.6 Dry grinding



DANGER!

Dust explosion!

There is a risk of spontaneous combustion especially for very fine metal oxides and a thus resulting dust explosion. Mind the external temperature and the pressure that can develop in the grinding bowl during the dry grinding.

NOTICE!

Dry grindings need to be checked in briefer intervals. Longer dry grindings, without pauses and checks, can cause the grinding set to gum up and to become damaged. In particular with agate, the grinding bowl and grinding balls can become damaged after a short grinding time.

At a particle size of less than 20 µm, the surface forces prevail. The grinding stock begins to stick.

Additional dry comminution can be achieved by adding surface-active substances to the material to be ground.

Examples (maximum amount to be added in mass %)

- Stearic acid 2-3 %
- Aerosil (fine-particle silicic acid) 0.5 - 2 %
- Quartz sand ~ 2 %
- Glass powder ~ 2 %
- Glycol (Ethylene glycol) ~ 0.1 - 0.5 % (≙ 5 - 25 droplets)
- Triethanolamine ~ 0.1 - 0.5 %

6.4.7 Wet grinding (grinding in a suspension)



DANGER!

Explosion hazard! Ignition hazard!

The device is not explosion-protected. If flammable liquids are used, make sure that the heat developing in the grinding bowl does not reach the solvent's boiling point. Program appropriate cooling phases. If the vapour pressure is too high, vapours may escape and ignite.

If it can be avoided, we recommend using non-flammable liquids or liquids with a high boiling point. The boiling point should be above 80 °C and above 100 °C for a long grinding duration.

During the transition to grinding in suspension, you can add a liquid auxiliary agent with high boiling point and low vapour pressure, e.g. water, white spirits (boiling point 100 - 140°C), or alcohols with a high boiling point (e.g. isopropanol)

We recommend that you only use so much liquid that the suspension has the same consistency as motor oil. With this viscosity the best results can be achieved in most cases.

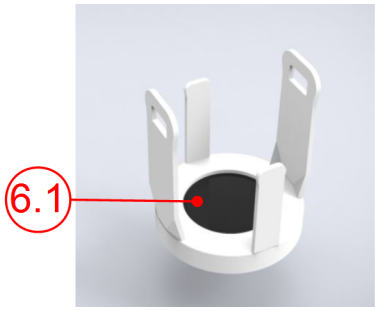
6.5 Clamping the grinding bowls

6.5.1 Clamping with the "Safe-Lock" (5) tensioning device



Fritsch GmbH confirms that every Safe-Lock clamping system has been manufactured and tested to our internal quality standards. Fritsch GmbH measures the clamping force of each individual Safe-Lock clamping system. The clamping force must be in the range of 11.2 - 11.3 kN +/- 0.2kN.

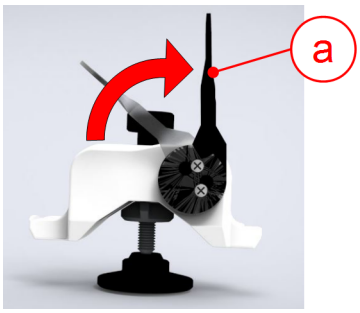
Using the device



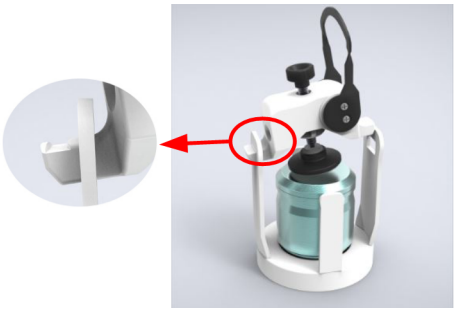
Prior to every grinding, carry out the following checks before clamping the grinding bowls:

- Has the rubber disk (6.1) been inserted into the grinding bowl holder? The rough side should be facing upwards!
- Check the rubber disk in the grinding bowl holder for damage:
  Replace the rubber disk if it has been pressed flat!
- The Teflon flat seal (for the sealing between lid and bowl) may not be damaged or soiled.
  Replace heavily deformed Teflon flat seals.
- The surfaces of the lids and bowls on which the Teflon flat seals lie must be clean!
- Check the rubber disk of the pressure piece for damage!
  Replace rubber disks that have been pressed flat and are protruding laterally from the pressure piece.
- Make sure that the thread on the Safe-Lock is not soiled and not damaged. Both can lead to a premature actuation of the torque spanner and thus preventing the required final clamping force from being reached.

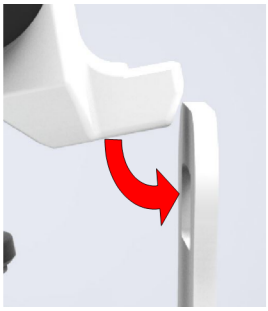
Clamping



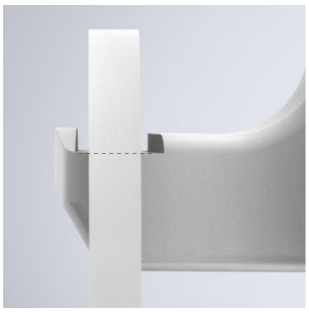
1. Position the bracket (a) of the clamping lever vertically!



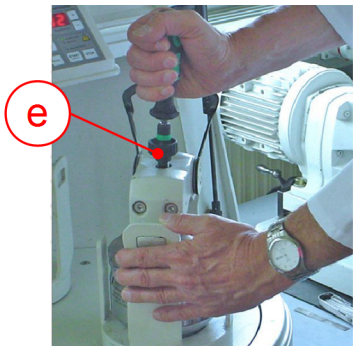
2. Hang the longer projection of the Safe-Lock clamping device onto the cut-out of the grinding bowl holder.



3. Hang the short projection of the Safe-Lock clamping device into the other side.



4. Push the Safe-Lock clamping device so that the cut-out of the grinding bowl holder sits centrally in the U-shaped cut-out of the longer projection.



5. Pre-tension the setting screw (e) manually, then place the provided torque spanner on the setting screw (e) and turn until it clicks. (2.6 Nm)

Make sure that you do not turn the torque spanner too fast. This could prevent the correct final clamping force from being reached.



6. Then press the clamping lever downwards.

7. Wait a few seconds. Release the Safe-Lock again and turn the setting screw (e) again using the torque spanner until it clicks.

8. Press the clamping lever downwards again. The Safe-Lock system is now tensioned!

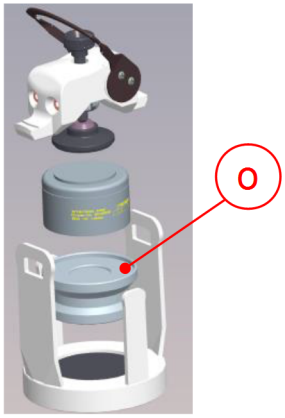
DANGER!

After several minutes of grinding and in the cooling-down phases, check that the tensioning device is firmly connected.

If the Safe-Lock system is correctly tensioned, the clamping lever is automatically pulled downwards by the eccentric when horizontal.

6.5.2 Clamping the 80 ml grinding bowls

There are two ways of clamping an 80 ml grinding bowl:



1. Place the reducer (o) (order no. 90.1120.09) into the grinding bowl holder and position the 80ml grinding bowl on it and fasten with the Safe-Lock tensioning device.



2. Alternatively, clamp two 80 ml grinding bowls on top of one another.

Tensioning with the Safe-Lock system proceeds as described in Chapter 6.5.1 'Clamping with the "Safe-Lock" (5) tensioning device' on page 35.

6.6 Mass balance

Load the laboratory planetary mill symmetrically.

Always clamp an equally heavy grinding bowl with lid and seal ring in the opposite grinding bowl holder to balance the weight!

Failing that, select an empty bowl as a counterweight. The empty bowl may be filled with sand as an additional weight.

NOTICE!

Extra weights, like "GTM" and "additional clamping system", have to be balanced as well.

6.7 Grinding duration



CAUTION!

Burn hazard!

Grinding bowls can get very hot after long grinding durations. Wear protective gloves for removal after grinding or during the grinding breaks.

Depending on the application, the grinding duration should be adapted to the development of heat in the bowls. The temperature inside the bowls can be much higher than the outer casing temperature.

CAUTION!

The maximum temperature of the grinding bowl outer casing is 100 - 110 °C (agate, max. 70 - 80 °C).

The grinding duration is therefore based on the maximum bowl temperature. The grinding duration at which the temperature is not exceeded depends on the material, ball, and speed. For this reason, the user should determine it through experimentation.

Reference value

When grinding at high speeds and with large bowls, a grinding duration of one hour (depending on the temperature) should not be exceeded. Then allow the unit to cool down for half an hour to one hour.

To what extent the heating up of the material to be ground needs to be observed naturally depends on the corresponding sample in each individual case. Note → a longer duration may also require a long pause time for cooling down.

To reduce the grinding time, you can use a grinding bowl and grinding balls with a higher density, and thus a higher impact energy.

The mill can also run for several hours during low-speed operations for mixing and homogenisation.

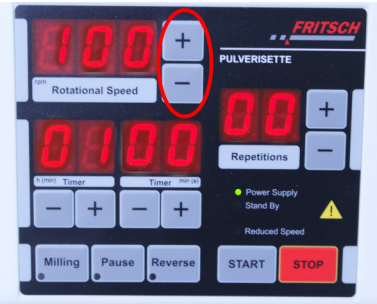
Operation with an external time switch is not possible.

6.8 Settings on the control panel

6.8.1 Setting the speed



- Switch on the main switch (10) on the back of the device (I).
- The green POWER SUPPLY ready status indicator lights up on the control panel.



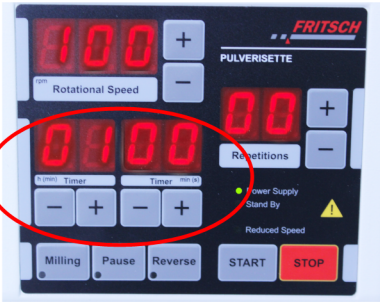
ROTATIONAL SPEED control panel area

Press and hold the + or - button.

The speed can be selected in steps of 10 between 50 and 400 1/min.

The actual speed is displayed during operation. The nominal speed is briefly displayed when the + or - button is pressed.

6.8.2 Setting the running time



TIMER control panel area

Setting the grinding time

1. Press the "MILLING" button.

   ⇨ The "MILLING" button lights up

2. Press the + or - buttons to set the running time in hours (0–99) and minutes (0–59) or in minutes (0–59 and seconds (0–59).

Set the pause time

1. Press the "PAUSE" button.

   ⇨ The "PAUSE" button lights up.

2. Press the + or - buttons to set the pause time in hours (0–99) and minutes (0–59) or in minutes (0–59 and seconds (0–59).

   If no pause time is required, set the pause time to 0.

- *If the combination minutes/seconds is set in setup mode instead of hours/minutes (see ↬ Chapter 4.6.2 'Setting time units' on page 24), the numbers at **h** indicate the minutes and at **min**, the seconds!*
  *The **factory setting** of the time unit is minutes and seconds. (Display: 1)*
- *The remaining running times and the pause times are displayed during operation.*
- *Operation with an external time switch is not possible.*
- *For running times see ↬ Chapter 6.4.1 'Running time (grinding duration)' on page 33.*
- *Interrupt grinding by pressing the STOP button. Continue grinding by pressing the START button. This takes into account the previous grinding duration and the number of repetitions.*

6.9 Repetition of grinding / pause cycles



REPETITIONS control panel area

Press + or - button; select the number of repetitions (0..99). The number of remaining cycles is displayed during operation.

6.10 Reverse mode

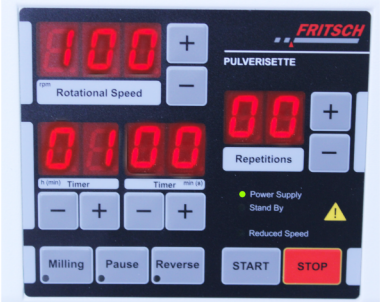


→Press the REVERSE button. The button lights up.

After the selected running time expires, the mill will change its direction of rotation. For this, REPETITIONS has to indicate at least 1.

"Reverse" is selected when mixing dry samples, for example.

6.11 Conducting a grinding operation



- After all the preparations described in ↳ *Chapter 6.1 'Choice of grinding bowls and grinding balls' on page 27* to ↳ *Chapter 6.10 'Reverse mode' on page 41* have been carried out, close the hood (3).
- Press the START button on the control panel.
- The hood is locked and the mill starts up.
- The mill turns at the set speed (nominal speed). If the load is too great, for example due to heavy grinding bowls, the speed is reduced (actual speed) so that the machine is not overloaded.
  → The "REDUCED SPEED" lamp is lit!

If the mill does not start, see ↳ Chapter 10 'Repairs' on page 57

While in operation, the hood (3) remains locked, even during pause times, and the fan cools the interior.

6.11.1 Overload

If the mill is overloaded, the speed is reduced and the REDUCED SPEED light flashes.

The mill switches off if the overload continues for too long; see ↳ *Chapter 10.1 'Checklist for troubleshooting' on page 57*.

6.11.2 Switching off

- Press STOP on the control panel.
- When the drive comes to a standstill, the hood is unlocked and can be opened.
- If the device is not in operation for a long time, switch off the main switch on the back side.

6.12 Cooling the grinding bowl



WARNING!

Burn hazard!

Grinding bowls can get very hot after long grinding durations. Wear protective gloves for removal after grinding or during the grinding breaks.

- When the hood is open (3), or
- In the programmed pause times with closed (locked) hood and the fan running.

6.13 Stand-by

If the mill is not in operation and the hood (3) is open, it switches to the energy-saving stand-by mode after one hour. The STAND-BY lamp lights.

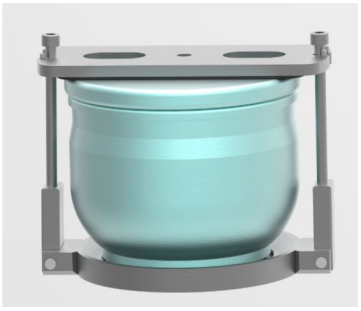
The stand-by function is not possible when the hood is closed.

7 Accessories

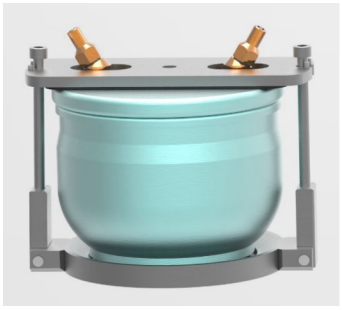
7.1 Additional clamping system for grinding harmful substances or in a gas atmosphere.

The additional clamping system is used to transport a grinding bowl filled with inert gas or harmful substances from a glove box to the planetary mill and back again. This ensures that no harmful substances can be inhaled.

There are two ways of gassing the grinding bowls:



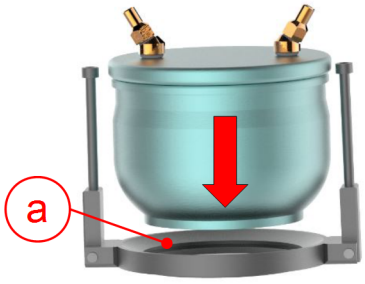
1. Grinding bowls with standard lids have to be filled in a glove box with an inert gas atmosphere and closed using the additional clamping system. Using this procedure you can even grind hazardous substances!



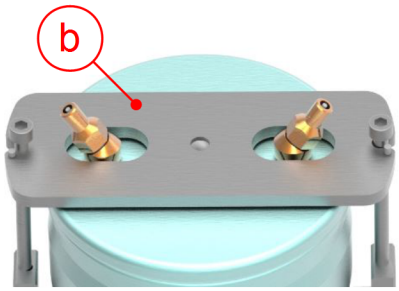
2. Grinding bowls with gassing lids can also be closed and gassed outside the device using the additional clamping system.

7.1.1 Locking the additional clamping system into place

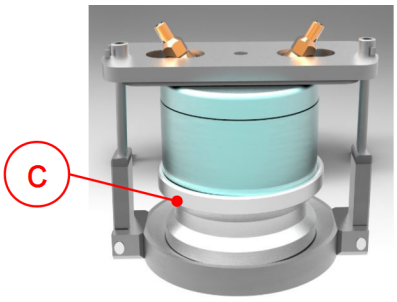
1. When using the additional clamping system, exchange the white Teflon seal with the fitting, enclosed black Viton seal for sealing the grinding bowl.



2. Place the grinding bowl in the grinding bowl adapter (a) of the additional clamping system.



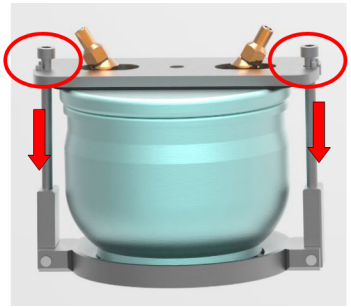
3. Position the pressure plate (b) with the rubber disk on the bowl as shown in the picture.



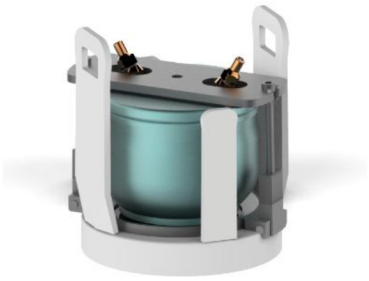
4.

NOTICE!

When using grinding bowls with a volume of 80 ml in the additional clamping system, the adapter piece (c) (90.1120.09) provided in the accessories must be used.



5. Then tighten both socket-head screws (d) shown in the diagram equally with a hex key and thereby clamp the pressure plate tightly. Ensure that the pressure plate is lying evenly on the bowl lid.

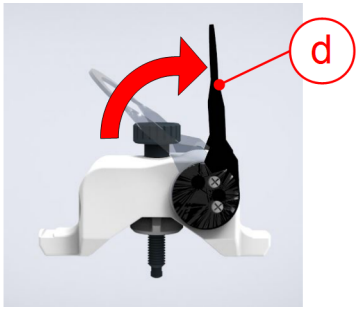


6. Place the additional clamping system with clamped bowl in the grinding bowl holder.

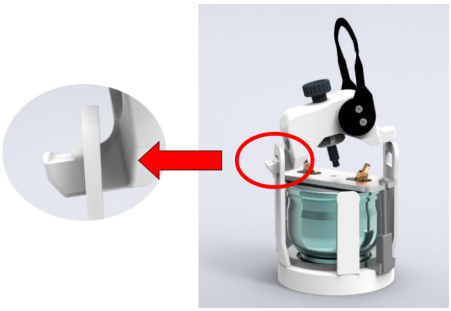
Accessories



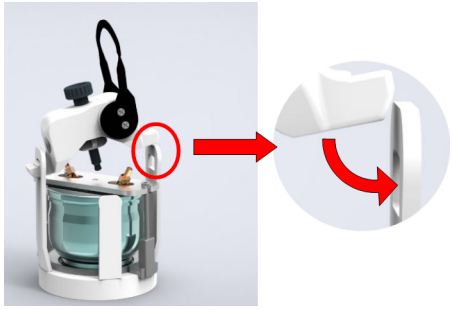
7. The pressure piece has to be removed in order to use the Safe-Lock system for clamping.



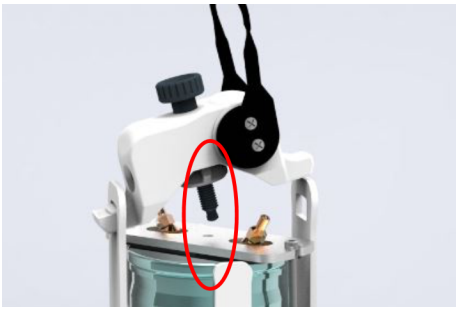
8. Position the bracket (d) vertically!



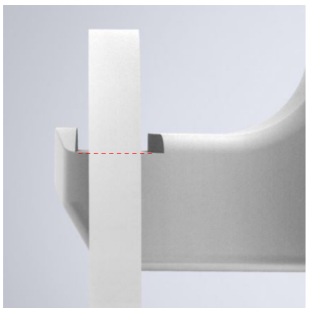
9. Hang the longer projection of the Safe-Lock clamping device into one side of the mounting of the grinding bowl holder.



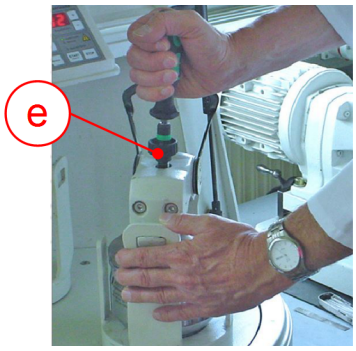
10. Hang the short projection of the Safe-Lock clamping device into the other side.



11. Ensure that the journal of the threaded spindle (where the pressure piece was previously affixed) is sitting in the bore hole provided in the pressure plate (b).



12. Push the Safe-Lock clamping device so that the mounting of the grinding bowl holder sits centrally in the U-shaped cut-out of the longer projection.



13. Pre-tension the setting screw (e) manually, and screw it tight using the provided torque spanner. Place the torque spanner provided on the setting screw (b) and turn until it clicks. (2.6 Nm)

Make sure that you do not turn the torque spanner too fast. This could prevent the correct final clamping force from being reached.



14. Then press the clamping lever downwards.

15. Wait a few seconds. Release the Safe-Lock again and turn the setting screw (e) again using the torque spanner until it clicks.

16. Press the clamping lever downwards again.

17. Re-tighten the screws in the additional clamping system with a hex key.

DANGER!
The additional clamping system may be loosened due to the clamping of the Safe-Lock using the clamping lever. Check the screw connections of the additional clamping system and the Safe-Lock tensioning device for tight fit before starting grinding. Failure to observe this instruction may lead to serious material damage or personal injury.

DANGER!
After several minutes of grinding and in the cooling-down phases, check that the tensioning device is firmly connected.

If the Safe-Lock system is correctly tensioned, the clamping lever is automatically pulled downwards by the eccentric when horizontal.

7.2 Grinding in inert gas with gassing lid

NOTICE!
Observe imbalance offsetting! (See *Chapter 6.6 'Mass balance' on page 38*).

NOTICE!
Before every grinding operation, check the valves of the gassing lid ensuring that they are clean and properly secured. See chapter *Chapter 7.2.4 'Cleaning the valves' on page 51*.

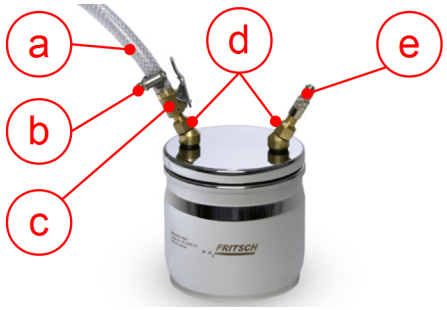
We carry out a worker water bath test on all gassing lids. The part to be tested is sealed, a pressure of 5.5 bar is applied and it is immersed in a water bath. If there is a leak, bubbles will develop. The air bubbles that develop within a specific interval are evaluated by the worker/tester.

Only gassing lids with a leak rate of < 10^{-4} [mbar l/s] are approved.

When grinding in inert gas, the same conditions apply regarding clamping and composition of grinding set and balls, as apply for standard grinding.

Two valves are screwed onto the gassing lid through which you can feed in inert gas (e.g. nitrogen) before switching on the mill. A Viton flat seal is used instead of a Teflon one.

7.2.1 Preparation for gassing



a Gassing hose
b Hose clamp
c Coupling
d Valves
e Ventilation attachment

- Fill the grinding bowl with grinding balls and grinding stock. (See ↳ *Chapter 6.3 'Filling the grinding bowl' on page 32*)
- Attach the Viton seal and lid.
- Insert the grinding bowl into the grinding bowl holder (8).
- Clamp the grinding bowl in the device (See ↳ *Chapter 6.5 'Clamping the grinding bowls' on page 35*)

Using the additional clamping system, the following steps can also be completed in the glove box and subsequently clamped in the Laboratory planetary mill:

- Connect the gassing hose (a) to the inert gas supply using the provided hose clamp (b).
- Screw the ventilation attachment (e) onto one of the two valves (d).
- Place the coupling (c) of the gassing hose on the free valve. When doing so, press the lever of the coupling and push the coupling along the neck of the valve until it goes no further. Release the lever.

Using the additional clamping system, the closed grinding bowl can also be tensioned and gassed outside of the device. (See ↳ Chapter 7.1.1 'Locking the additional clamping system into place' on page 44)

7.2.2 Gassing

- Slowly open the inert gas supply.
- Press a thin object (e.g. hex key) onto the top of the ventilation attachment (e) so that the air can escape from the grinding bowl.
- The inert gas now purges the air from the grinding bowl.
- The duration of purging has to be determined through experimentation.

  It depends on grinding bowl size, filling, and gas supply, among other factors.
- To end purging, close the inert gas supply and release the ventilation attachment.
- Screw off the ventilation attachment.
- Remove the gassing hose. To do so, press the lever.

CAUTION!

Only switch on the device when both coupling and ventilation attachment have been removed.

Overpressure may occur during grinding!

7.2.3 Ventilate after grinding



CAUTION!

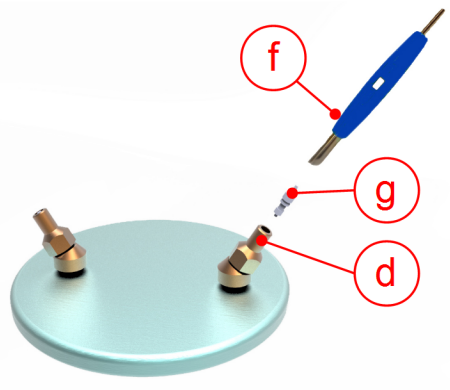
Always let the bowl cool down before ventilation. Hot gases and sample material may escape from the bowl during pressure equalisation, leading to serious burns.

→ Use protective gloves when ventilating!

- When the bowl has cooled down, remove the additional clamping system with bowl from the device.
- Screw the ventilation attachment onto the valve.

  Each valve can be used for aerating or ventilating.
- For pressure equalisation (of the overpressure occurring because of grinding), carefully press on the ventilation attachment with a thin object (e.g. hex key).
- Only now should you release the additional clamping system (5)!

7.2.4 Cleaning the valves



f Valve screwdriver
g Valve insert (84.6360.00)
d Valves

Both valves (d) should be cleaned after every grinding!

- Insert the thin end of the valve screwdriver (f) from above into the valve (d) and turn anti-clockwise.
- Screw out the valve insert (g).
- Depending on the soiling, clean the valve insert (g) with compressed air, or place it in a small glass container filled with alcohol and clean in an ultrasonic cleaner (LABORETTE 17) and then dry carefully.
- After the two valve inserts have been removed, the two valve holders can be cleaned with compressed air from above the lid.

7.2.5 Installing valve inserts

- Insert the valve insert (g) into the valve (d) with the spring pointing upwards.
- With the valve screwdriver (f), screw the valve insert clockwise.

The following gassing lids for the grinding sets are available, each with two valves and a soft sealing ring:

Material	Order number
Hardmetal tungsten carbide 80 ml	50.8880.00
Hardmetal tungsten carbide 250 ml	50.8600.00
Hardened, stainless steel 80 ml	50.8700.00
Hardened, stainless steel 250 ml	50.8500.00
Hardened, stainless steel 500 ml	50.8400.00
Agate 80 ml	50.8100.00
Agate 250 ml	50.8100.00
Agate 500 ml	50.8010.00
Zirconium oxide 80 ml	50.8840.00
Zirconium oxide 250 ml	50.8950.00
Zirconium oxide 500 ml	50.9100.00
Silicon nitride 250 ml	50.8900.00
Silicon nitride 500 ml	50.9150.00

NOTICE!

The soft black sealing rings made of "Viton" can endure temperatures of approx. 200 °C.

The valves (d) can endure temperatures of approx. 180 °C for one hour at most.

NOTICE!

The grinding parts made of agate are only designed for temperatures of up to 100 °C. After this point, they need to be slowly and carefully cooled down.

7.3 GTM - system

The GTM system is available as an accessory for recording pressure and temperatures in the grinding bowl during grinding.

Instructions are included with the GTM system.

8 Cleaning



DANGER!

Mains voltage!

- Before beginning with cleaning work, disconnect the mains plug and protect the device against being unintentionally switched back on!
- Do not allow any liquids to flow into the device.
- Indicate cleaning work with warning signs.
- Put safety equipment back into operation after cleaning work.



When cleaning the entire device, adhere to the guidelines of the Accident Prevention Regulation (BGV A3) - especially when the device has been set up in a dusty environment or when the grinding stock processed produces dust.

8.1 Grinding elements



NOTICE!

Cool grinding elements made of agate, sintered corundum, zirconium oxide and silicon nitride slowly and carefully.

Do not heat agate elements in a microwave under any circumstances (heating is too fast).

They must never be exposed to thermal shocks as this could cause irreparable damage to the parts → They will burst apart like in an explosion.

- Clean the grinding bowl and grinding balls each time after using them: Clean them, e.g., under running water using a brush and a commercially available cleaning agent.
- Half fill the grinding bowl with grinding balls, sand and water, and run with maximum speed for 2 to 3 minutes (correctly tensioned) in the Laboratory planetary mill.
- Cleaning with an ultrasonic cleaner is permitted.
- For sterilisation in the heat cabinet, only heat the grinding elements up to 100 °C.

8.2 Device

- The planetary mill can be wiped down with a damp cloth when it is switched off.

9 Maintenance



DANGER!

Mains voltage

- Before beginning with maintenance work, unplug the mains plug and protect the device against being unintentionally switched back on again!
- Indicate maintenance work with warning signs.
- Maintenance work may only be performed by specialised personnel.
- Put safety equipment back into operation after maintenance or repair work



NOTICE!

Send all Safe-Lock clamping systems to Fritsch GmbH once a year for inspection. The customer must bear the costs of this maintenance itself.



We recommend keeping a safety logbook Chapter 15 'Safety logbook' on page 66, where all work (maintenance, repairs.....) performed on the device is entered.



The most important element of maintenance is regular cleaning!

Functional part	Task or description	Test	Maintenance interval
Safety lock	Hood lock (7)	Is the closed hood (3) locked in place when the main switch is off? If this test is failed, do not continue to work until the fault has been rectified.	Before each use
Rotating bearings	Permanent lubrication	Bearing clearance	Every 2,000 h or annually
Drive motor	Permanent lubrication	Bearing clearance	Every 4,000 h or annually

Maintenance

Functional part	Task or description	Test	Maintenance interval
V-belt	Motor planetary disc	Check belt tension Disconnect the device from the mains. Screw off the top rear cover plate. The belt must not slacken by more than 10 mm when pushed with your thumb.	Once a year
Fan, ventilation slots (13)	Grinding chamber cooling and electronics	Clean functional parts when soiled (right and left side of the device, as in the interior)	Twice a year
Grinding bowl tensioning device, Safe-Lock (5) (Fig. 1)	Rubber of the pressure piece and rubber disc in the grinding bowl holder	Signs of use; replace if pressed flat and no longer elastic	After every 1,000 h
	Indicated surfaces of Safe-Lock (Fig. 1) Original height 12.5 mm Minimum height 12 mm (y)	The areas indicated demonstrate a high degree of wear and do not meet the minimum height.	After every 200 h If the height is under the minimum height, the corresponding part has to be replaced.
Grinding bowl lid seal	Seal the grinding bowl	Replace seal if dirt has penetrated	Before each use
Grinding bowl holder (8) (Fig. 2)	Keep tension Original height 14 mm	Minimum measurement at grinding bowl holder 11 mm (x)	After every 200 h Check minimum height as shown in Fig. 2. If the height is under the minimum height, the corresponding part has to be replaced.

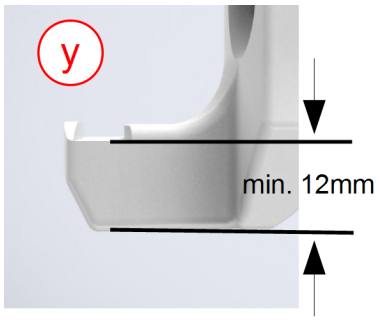


Abb. 1

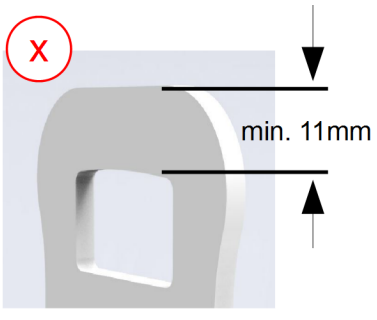


Abb. 2

10 Repairs



DANGER!

Mains voltage!

- Before beginning with repair work, unplug the mains plug and protect the device against being unintentionally switched back on.
- Indicate repair work with warning signs.
- Repair work may only be performed by specialised personnel.
- Put safety equipment back into operation after maintenance work.

10.1 Checklist for troubleshooting

Fault description	Cause	Remedy
The POWER SUPPLY ready status indicator doesn't light up	No mains connection	Plug in mains plug.
	Main switch (10) at 0 (OFF)	Switch on main switch.
	Excess current protection switch has been triggered	Press the excess current protection switch (9) on the back of the device.
"START" button is pressed but mill does not start up	POWER SUPPLY does not light up	see above
	Pause time active	Wait for end of pause or press "STOP".
	Safety lock was opened manually	Reactivate the safety lock, see *Chapter 2.6 'Protective equipment' on page 13*
Mill reduces speed automatically	If REDUCED SPEED is lit: Overload	Reduce load or accept automatically set speed.
Mill stops running	Switched off due to thermal overload of the drive	Allow device to cool down and select a lower speed.
	Imbalance of machine too high	Improve mass balance. (See *Chapter 6.6 'Mass balance' on page 38*).
	Imbalance check has been triggered.	Check grinding bowl weight; adjust imbalance check sensitivity (see Chapter *Chapter 4.6.1 'Setting the imbalance check' on page 23*)
	Drive was blocked	Rectify malfunction in grinding chamber.
	Motor's V-belt loose or ripped	Check V-belt, replace if necessary.
	Speed sensor is defective	Contact customer service.
The hood cannot be opened.	The hood handle (1) was not properly operated during opening.	Unlock the hood handle by pressing!

Fault description	Cause	Remedy
The hood cannot be opened.	No mains connection	Plug in mains plug.
	Main switch at 0 (OFF)	Switch on main switch (I).
	Excess current protection switch has been triggered	Press the excess current protection switch (9) on the back of the device
Grinding stock escapes	Tensioning device (5) loose	Check and re-tension if necessary
	Seal ring between bowl and lid soiled or defective	Clean or replace seal ring.
Runs unevenly with strong vibrations	Bowls are imbalanced	Align the bowls symmetrically (equal masses in the opposing position)

10.2 Error messages

No.	Fault description	Cause	Remedy
01	Con	Frequency converter failed	Contact Fritsch Service!
02	Con	Frequency converter operational error	Contact Fritsch Service!
03	UnbA	Imbalance check has switched off	Remove imbalance; check weights of grinding sets Set the imbalance check (see *Chapter 4.6.1 'Setting the imbalance check' on page 23*)
04	Cond	Motor relay has not switched	Check manual release at safety switch or plug of safety switch
05	EStP	Emergency stop switch pressed	Unlock emergency stop switch
06	Lid	Hood not closed	Close hood properly
07	Lid	Event during hood monitoring	Close hood properly
08		STO safety switch faulty	Contact Fritsch Service!
09	Hot	Motor over-heated	Allow motor to cool down
11	HALt	Standstill of main disk detected	Contact Fritsch Service!

11 Examples of comminution tasks

Material			
Feeding amount	**Material of grinding bowl and balls**	**Grinding balls, St. x diameter**	**Result**
Feed size	**Grinding bowl size**	**Grinding duration**	**Final fineness**
Ruby (stone)			
140 g	Cr-Ni steel	6 x 30 mm	100%
12 mm	250 ml	3 min	< 250 µm
Titanium dioxide TiO_2 (dry and wet grinding in water)			
40 g	Cr-Ni steel	6 x 30 mm	100%
2 mm	250 ml	30 min	< 40 µm
Titanium dioxide TiO_2 (wet grinding in water)			
40 g / 50 ml water	Cr-Ni steel	6 x 30 mm	100%
2 mm	250 ml	60 min	< 10 µm
Coal (dry and wet grinding in water)			
5 g	Zirconium oxide	5 x 20 mm	100%
0.5 mm	80 ml	120 min	< 15 µm
Aluminium oxide / silicon oxide			
100 g	WC + Co	15 x 20 mm	90%
0.1 mm	250 ml	90 min	< 20 µm
Ferrovanadium			
70 g	WC + Co	5 x 30 mm	70%
3 mm	250 ml	20 min	< 100 µm
Glass			
50 g	Agate	15 x 20 mm	100%
4 mm	250 ml	15 min	< 90 µm
Silicon carbide (dry and wet grinding in water)			
15 g	WC + Co	5 x 20 mm	100%
3 mm	80 ml	30 min	< 150 µm
Silicon carbide (dry and wet grinding in water)			
15 g / 5 ml water	WC + Co	5 x 20 mm	100%
3 mm	80 ml	45 min	< 71 µm

Examples of comminution tasks

Raw phosphate			
40 g	Cr steel	15 x 20 mm	100%
3 mm	250 ml	2 min	< 250 µm
Manganese dioxide MnO_2 (wet grinding in water)			
50 g / 40 ml water	WC + Co	15 x 20 mm	100%
0.1 mm	250 ml	60 min	< 20 µm
Sludge (dry)			
180 g	Al_2O_3	10 x 30 mm	100%
8 mm	500 ml	30 min	< 250 µm
Active carbon (wet grinding in water)			
150 ml	Cr-Ni steel	15 x 20 mm	100%
0.025 mm	250 ml	30 min	< 5 µm
Plaster			
300 g	Cr steel	10 x 30 mm	100%
10 mm	500 ml	20 min	< 200 µm
Protein			
50 g	Sintered corundum 1	6 x 30 mm	90%
20 mm	250 ml	90 min	< 50 µm
Grains (barley)			
100 g	Sintered corundum 1	3 x 40 mm	100%
3 mm	500 ml	20 min	< 150 µm
Dough products			
100 g	Sintered corundum 1	10 x 30 mm	100%
5 mm	500 ml	3 min	< 250 µm
Sugar (wet grinding in alcohol)			
200 g	Agate	10 x 30 mm	100%
1 mm	500 ml	45 min	< 10 µm

12 Disposal

It is hereby confirmed that FRITSCH has implemented the directive 2002/95/EC of the European Parliament and Council from 27th January 2003 for the limitation of the use of certain dangerous substances in electrical and electronic devices.

FRITSCH has registered the following categories according to the German electrical and electronic equipment act, section 6, paragraph 1, clause 1 and section 17, paragraphs 1 and 2:

Mills and devices for the preparation of samples have been registered under category 6 for electrical and electronic tools (except for large stationary industrial tools).

Analytical devices have been registered under category 9, monitoring and control instruments.

It has been accepted that FRITSCH is operating only in the business-to-business area. The German registration number for FRITSCH is WEEE reg. no. DE 60198769

FRITSCH WEEE coverage

Since the registration of FRITSCH is classified for bilateral transactions, no legal recycling or disposal process is described. FRITSCH is not obliged to take back used FRITSCH devices.

FRITSCH declares it is prepared to take back used FRITSCH devices for recycling or disposal free of charge whenever a new device is purchased. The used FRITSCH device must be delivered free of charge to a FRITSCH establishment.

In all other cases FRITSCH takes back used FRITSCH devices for recycling or disposal only against payment.

13 Guarantee terms

Guarantee period

As manufacturer, FRITSCH GmbH provides – above and beyond any guarantee claims against the seller – a guaranty valid for the duration of two years from the date of issue of the guarantee certificate supplied with the device.

Within this guarantee period, we shall remedy all deficiencies due to material or manufacturing defects free of charge. Rectification may take the form of either repair or replacement of the device, at our sole discretion. The guarantee may be redeemed in all countries in which this FRITSCH device is sold with our authorisation.

Conditions for claims against the guarantee

This guarantee is subject to the condition that the device is operated according to the instructions for use / operating manual and its intended use.

Claims against the guarantee must include presentation of the original receipt, stating the date of purchase and name of the dealer, together with the complete device type and serial number.

For this guarantee to take effect, the answer card entitled "Securing of Guarantee" (enclosed with the device) must be properly filled out and despatched without delay after receipt of the device and be received by us within three weeks or alternatively, *online registration* must be carried out with the above-mentioned information.

Reasons for loss of the guarantee

The guarantee will not be granted in cases where:

- Damage has arisen due to normal wear and tear, especially for wear parts, such as: Crushing jaws, support walls, grinding bowls, grinding balls, sieve plates, brush strips, grinding sets, grinding disks, rotors, sieve rings, pin inserts, conversion kits, sieve inserts, bottom sieves, grinding inserts, cutting tools, sieve cassettes, sieve and measuring cell glasses.
- Repairs, adaptations or modifications were made to the device by unauthorized persons or companies.
- The device was not used in a laboratory environment and/or has been used in continuous operation.
- Damage is present due to external factors (lightning, water, fire or similar) or improper handling.
- Damage is present that only insubstantially affects the value or proper functioning of the device.
- The device type or serial number on the device has been changed, deleted, removed or in any other way rendered illegible
- The above-mentioned documents have been changed in any way or rendered illegible.

Costs not covered by the guarantee

This guarantee excludes any costs for transport, packaging or travel that accrue in the event the product must be sent to us or in the event that one of our specialist technicians is required to come to your site. Any servicing done by persons not authorised by us and any use of parts that are not original FRITSCH accessories and spare parts will void the guarantee.

Further information about the guarantee

The guarantee period will neither extend nor will a new period of guarantee begin in the event that a claim is placed against the guarantee.

Please provide a detailed description of the type of error or the complaint. If no error description is enclosed, we shall interpret the shipment as an assignment to remedy all recognisable errors or faults, including those not covered by the guarantee. Errors or faults not covered by the guarantee shall in this case be rectified at cost.

We recommend reading the operating manual before contacting us or your dealer, in order to avoid unnecessary inconvenience.

Ownership of defective parts is transferred to us with the delivery of the replacement part; the defective part shall be returned to us at buyer's expense.

NOTICE!

Please note that in the event that the device must be returned, the device must be shipped in the original Fritsch packaging. Fritsch GmbH denies all liability for any damage due to improper packaging (packaging not from Fritsch).

Any enquiries must include a reference to the serial number imprinted on the type plate.

14 Exclusion of liability

Before using the product, be sure to have read and understood this operating manual.

The use of the product requires technical knowledge; only commercial use is permitted.

The product may be used exclusively within the scope of applications set down in this operating manual and within the framework of guidelines put forth in this operating manual and must be subject to regular maintenance. In case of non-compliance, improper use or improper maintenance, the customer assumes full liability for the functional capability of the product and for damage or injury arising from violating these obligations.

The contents of this operating manual are subject in entirety to copyright law. This operating manual and its contents may not be copied, further distributed or stored in any form, in part or in whole, without the prior written consent of Fritsch.

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FRITSCH GMBH expressly reserves the right to modify and/or update this operating manual without prior notice. The same applies to modifications and improvements to the products described in this operating manual. It is the responsibility of the user to ensure that they have the current version of this operating manual. For more information, please contact your local FRITSCH GMBH distributor or Fritsch GmbH, Industriestr. 8, D-55473 Idar-Oberstein.

Not all parts shown here are necessarily installed in the product. The buyer is not entitled to delivery of these parts. If interested, please contact your local FRITSCH GMBH distributor or Fritsch GmbH, Industriestr. 8, D-55743 Idar-Oberstein.

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15 Safety logbook

Date	Maintenance / Repair	Name	Signature

16 Index

A

Accident prevention 8
Additional clamping system 44
Authorised persons 8

B

Ball
  Number 34
  Size 34
Basic structure 7

C

Clamping 80 ml bowls 38
Clamping grinding bowl with the "Safe-Lock" clamping device 35
Cleaning grinding elements 53
Cleaning the mill 53
Cleaning the valves 51
Conducting a grinding operation 42
Cooling grinding bowls 43
Current consumption 17

D

Dimensions 17
Disposal 61
Dry grinding 34

E

Electrical connection 21
Electrical safety 18
Examples of comminution tasks 59
Exclusion of liability 64
Explanation of signs 10
Explanation of symbols 10

F

Filling quantity of grinding bowls 31
Final fineness 18

G

Grinding bowl
  Filling 32
Grinding duration 39
Grinding in inert gas 48
Grinding time 33
GTM - system 52
Guarantee terms 62

H

Hazardous points 15

I

Imbalance 14
Imbalance check 14
  Setting 23
Initial start-up 26
Installing valve inserts 51

M

Maintenance 55
Mass balance 38
Material 18

N

Number of balls per bowl 30

O

Opening the hood without mains connection 14
Operating noise 17
Operating principle 9
Overload 42
Overload protection 16

P

Power consumption 18
Preparing gassing 49
Protection against restart 16
Protective equipment 13

Index

R

Repairs 57
Repetition of grinding / pause cycles 41
Requirements for the user 8
Reverse mode 33, 41
Rotational speed 33

S

Safety information 10
Safety logbook 66
Scope of application 8
Selecting the grinding balls 27
Selecting the grinding bowl 27
Setting the grinding duration 40
Setting the speed 40
Setting up 20
Setup mode
- Setting device specifications 25
- Setting the imbalance check 23
- Setting time units 24

Size of the grinding balls 29
Skilled workers 8
Stand By - Mode 43

T

Troubleshooting checklist 57

U

Unpacking 19
Unwuchterkennung 16

V

Ventilating after grinding 50
Voltage 17

W

Warning information 10
WEEE 61
Weight 17
Wet grinding 35

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